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Angiographical Change of Guglielmi Detachable Coils

Treated Cerebral Aneurysm in Acute Stage

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Summary

Acute angiographical changes for preventing acute rebleeding on GDC treated cerebral aneurysms were evaluated.

From December 2000 to November 2002, 48 total aneurysms in 44 consecutive patients with acute SAH. Acute angiographical evaluations were carried out in 46 aneurysms, including 42 ruptured and 4 unruptured aneurysms. Two cases were excluded because of poor medical condition. In this series, there were no rebleeding cases in acute stage.

In the initial embolization for the 46 aneurysms, CO was achieved in eight aneurysms, NR in 15 aneurysms and BF in 23 aneurysms. Acute angiographical observations showed progressive thrombosis in 17 aneurysms (37%). No changes were observed in remaining 29. No recanalization was observed in this series. Only one case of BF, inside the aneurysm bleb was still observed during follow up. Additional embolization was carried out.

Progressive thrombosis was frequently observed in GDC treated cerebral aneurysms during acute stage. This angiographical finding seems to show prevention of rebleeding, which is considered important for the management of GDC treatment in acutely ruptured cerebral aneurysm.

Introduction

The endovascular treatment of ruptured cerebral aneurysms using Guglielmi detachable coil (GDC) has produced encouraging results in preventing rebleeding in the acute phase of subarachnoid haemorrhage (SAH) [3,4,8]. However, an acute rebleeding case in which there had been technically satisfactory GDC procedure was experienced (figure 1). Since that time, confirmation of the angiographical changes on GDC treated ruptured cerebral aneurysm has been scheduled.

The purpose of this paper is to evaluate the acute angiographical findings and post treatment management on acutely ruptured cerebral aneurysms.

Clinical Material and Methods

From December 2000 to November 2002, there have been 44 consecutive patients with acute SAH and 48 aneurysms treated using the GDC system at the Mito National Hospital.

All of the GDC treatments were performed under general anesthesia, and spinal drainage was inserted before the GDC treatment. Systemic anticoagulation with heparin was used in selected cases to decrease the rate of embolic complications.

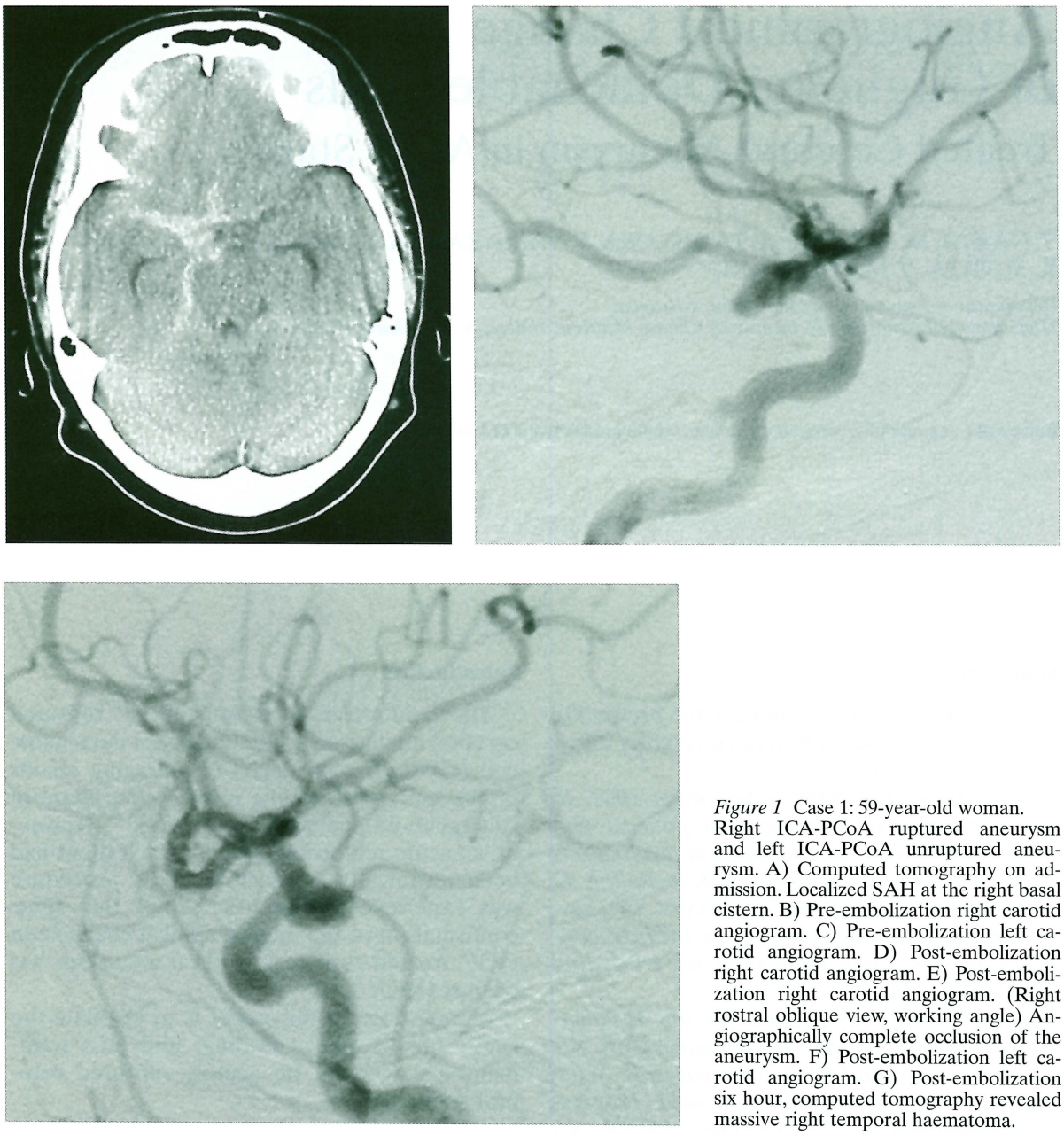


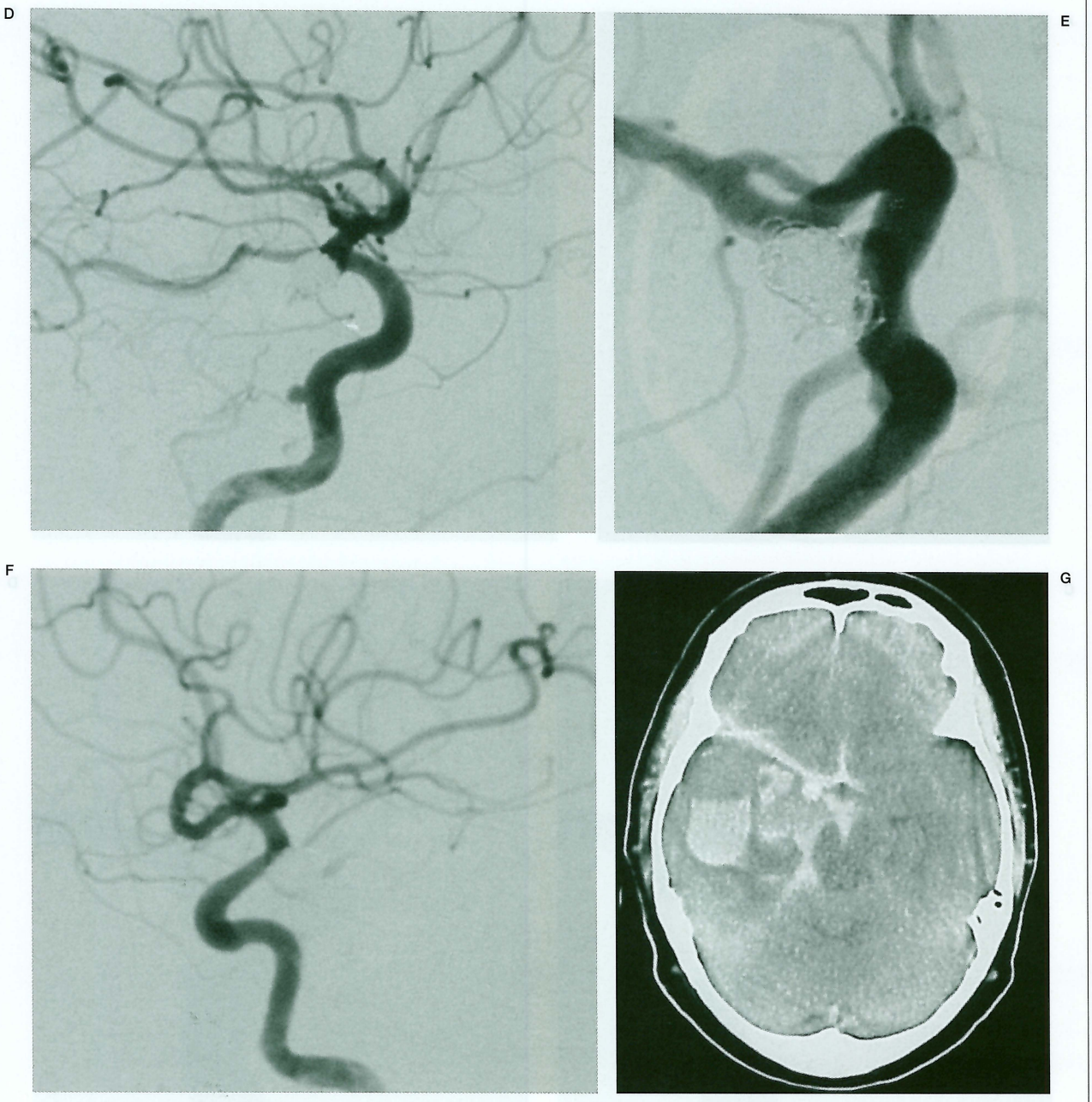
Figure 1 Case 1: 59-year-old woman. Right ICA-PCoA ruptured aneurysm and left ICA-PCoA unruptured aneurysm. A) Computed tomography on admission. Localized SAH at the right basal cistern. B) Pre-embolization right carotid angiogram. C) Pre-embolization left carotid angiogram. D) Post-embolization right carotid angiogram. E) Post-embolization right carotid angiogram. (Right rostral oblique view, working angle) Angiographically complete occlusion of the aneurysm. F) Post-embolization left carotid angiogram. G) Post-embolization six hour, computed tomography revealed massive right temporal haematoma.

All aneurysms were treated using the GDC system until dense packing for preventing the rebleeding was achieved. In the acute angiographical evaluation within 24 hours, after confirmation of aneurysmal obliteration and prevention of the occurrence of rebleeding, continuous general anesthesia was stopped.

Acute angiographical evaluations were carried out in 46 aneurysms, including 42 ruptured and 4 unruptured aneurysms.

Two cases were excluded because of poor medical conditions. The state of aneurysmal obliteration was evaluated using angiography in multiple projections.

The angiographical results were categorized as follows: complete occlusion (CO), where there is no contrast filling of the dome, body, or neck of the aneurysm; neck remnant (NR), where there is some contrast filling into part of the neck of the aneurysm; and body filling



(BF), where there is some contrast filling into the aneurysm's dome.

Representative Case Illustrations

Case 1: A 59-year-old woman with an acutely ruptured right internal carotid artery – posterior communicating artery (ICA-PCoA) aneurysm and unruptured left ICA-PCoA aneurysm was treated using the GDC system. However, CO was archived for bilateral ICA-PCoA aneurysm in initial treatment, and acute rebleeding occurred in six hours in the right ICA-PCoA aneurysm after treatment. Angiogram taken at this time showed no change in CO (figure 1).

Case 2: A 78-year-old woman with an acutely ruptured anterior communicating artery

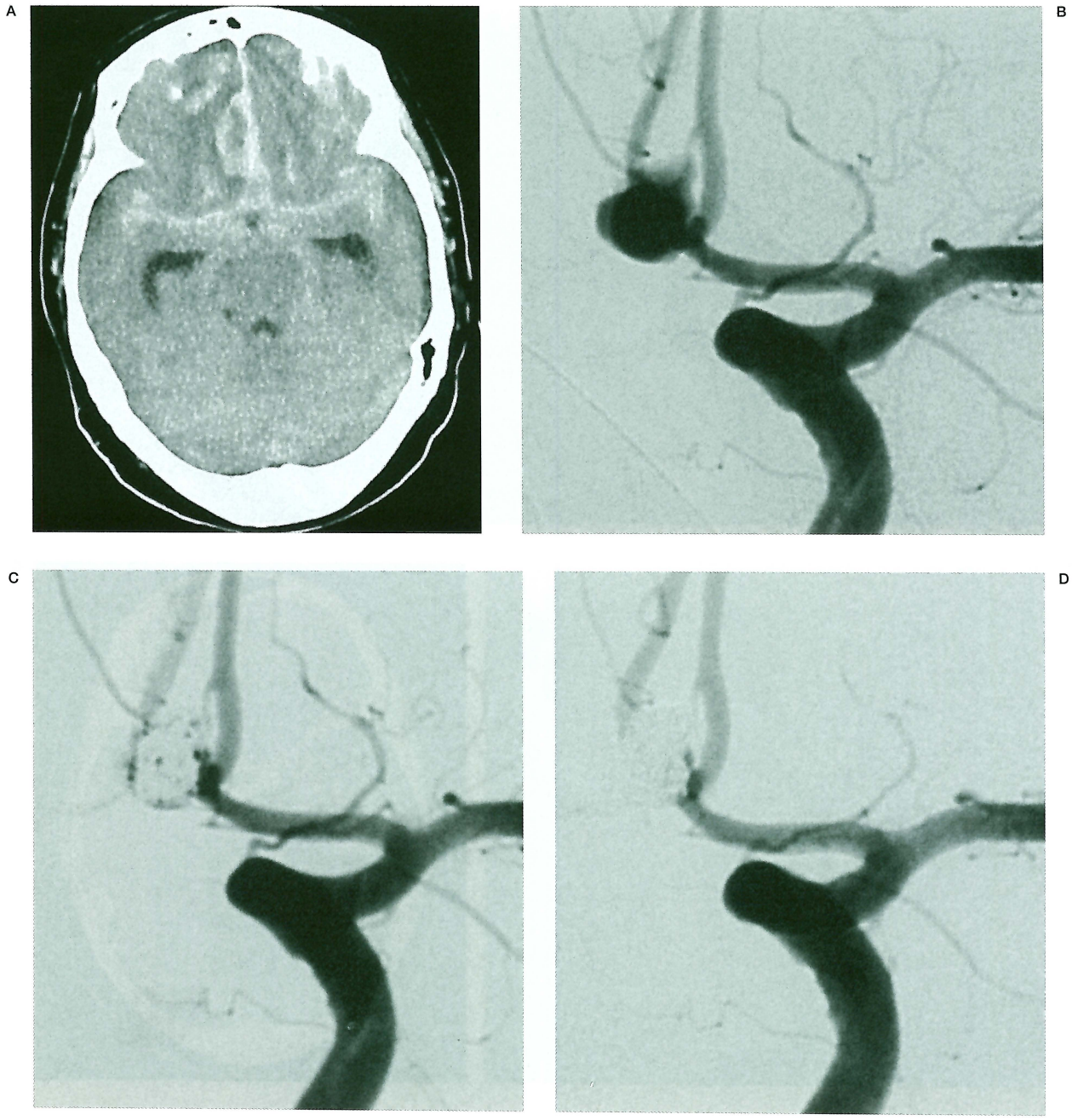


Figure 2 Case 2: 78-year-old woman. ACoA ruptured aneurysm. A) Computed tomography on admission. Diffuse SAH and right frontal hematoma. B) Pre-embolization left carotid angiogram. C) Immediately after embolization, left carotid angiogram revealed some contrast filling in the aneurysm body (BF). D) Post-embolization 20hour, left carotid angiogram revealed complete occlusion of the aneurysm.

(ACoA) aneurysm was treated using the GDC system. However, BF was observed in initial treatment. 20 hours after initial treatment, follow up angiogram showed progressive thrombosis (figure 2).

Results

Location of Aneurysm

Locations of the 42 ruptured aneurysms were as follows: 16 were at the internal carotid artery (ICA); 15 were at the anterior communi-

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cating artery (ACoA); five were at the middle cerebral artery (MCA); four were at the anterior cerebral artery (ACA); and two were at the vertebro-basilar artery (V-BA). Location of the four unruptured aneurysm were as follows; one was at the ACoA, one was at the ICA, and two were at the MCA (table 1).

Acute Stage Angiographical and Clinical Follow-up Results

No acute rebleeding cases were observed in this series. In the initial embolization for the 46 aneurysms, CO was achieved in eight aneurysms, NR in 15 aneurysms and BF in 23 aneurysms. Acute angiographical observations showed progressive thrombosis in 17 aneurysms (37%) (figure 2). No changes were observed in remaining 29. No recanalization was observed in this series. Only one case of BF, inside the aneurysm bleb was still observed during follow up. Additional embolization was carried out.

Following initial treatment on 23 aneurysms of BF, ten progressed to CO, five to NR, and eight showed no change. Following initial treatment on 15 of NR, two progressed to CO, and 13 showed no changes. Following initial treatment on eight of CO, all cases showed no change (figure 3). It is expected that pooling of the contrast medium in GDC treated cerebral aneurysms will provided the highest rate of progressive thrombosis.

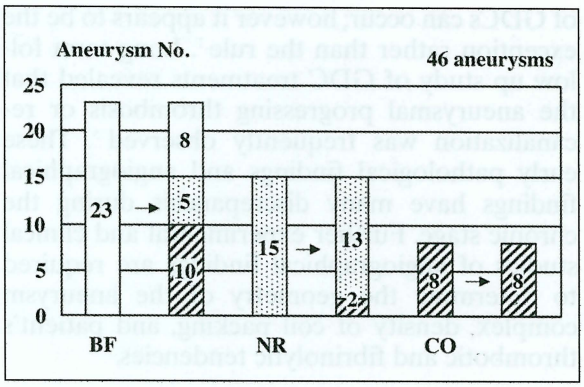

Figure 3 Acute angiographical follow-up results in 46 aneurysms.

Discussion

After GDC treatments rebleeding risks have been reported, but there is usually association with incomplete embolization [2]. However, an acute rebleeding case in which there had been technically satisfactory GDC procedure was experienced. This is a serious problem; it seems that the angiographical complete obliteration is not equal to the complete prevention for the rebleeding.

Complete aneurysmal occlusion using GDC is presumably influenced by several factors (aneurysm diameter, direct inflow etc...) [7]. However, in the ruptured aneurysms, the morphology of a rupture point is unstable, therefore the tight packing of GDC is often dangerous and difficult. The early angiographical changes of the GDC treated cerebral aneurysms showed progressive thrombosis as a possible prevention of rebleeding. These angiographical findings supported the treatment protocol: Continuous general anesthesia for several hours following the GDC treatment seems to reduce the risk of early aneurysmal rebleeding.

Stiver et Al reported that a histopathological examination of acutely ruptured ACoA aneurysm, treated 36 hours earlier by GDC treatment, revealed the formation of a fibrin membrane completely covering the aneurysm orifice. They suggest that the formation of a fibrin membrane across the aneurysm orifice during the early stages after GDC treatment is important because it serves a substrate for endotherialization and isolates the aneurysm sac from circulation [6]. These histopathological findings may support studies in acute stage.

Bavinzski et Al suggested that endothelialization of the aneurysm orifice following placement

Table 1 **Location of Aneurysm**

Location of the Aneurysm	Ruptured Aneurysm	Unruptured Aneurysm
ACoA	15	1
ACA	4	
ICA	16	1
MCA	5	2
V-BA	2	
total	42	4

Abbreviations:
ACoA = Anterior Communicating Artery;
ACA = Anterior Cerebral Artery; ICA = Internal Carotid Artery;
MCA = Middle Cerebral Artery; V-BA = Vertebro- Basilar Artery

of GDCs can occur; however it appears to be the exception rather than the rule [1]. Long term follow up study of GDC treatments revealed that the aneurysmal progressing thrombosis or recanalization was frequently observed [5]. These early pathological findings and angiographical findings have many discrepancies during the chronic stage. Further experimental and clinical studies of angiographical findings are required to determine the geometry of the aneurysm complex, density of coil packing, and patient's thrombotic and fibrinolytic tendencies.

Conclusions

Progressive thrombosis was frequently observed in GDC treated cerebral aneurysms during acute stage. The mechanism of progressive thrombosis in this series is uncertain, and discussion of the pathogenesis is necessarily speculative. This angiographical finding seems to show prevention of rebleeding, which is considered important for the management of GDC treatment in acutely ruptured cerebral aneurysm.

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